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TRANSFER OF PELET MACHINE PARAMETERS FROM SCADA TO ANDROID THROUGH PHP

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ABSTRACT

The population of living beings in the world is increasing day by day. Therefore, the necessary steps have been taken with the industrial revolution to make the productions in the world high speed and fast. Heavy machinery facilities have taken the works carried out by human beings over and this has led to an increase in production. Technological developments have changed the working principle of heavy machines day by day. Steam powered machines started to work with electrical energy and controls were made according to remote control system. The development of computer technology has brought this control system to another dimension and introduced the PLC and SCADA system to the industrial facilities. Today, information sharing is very important as a result of these developments. In line this demand, it is thought to transfer the information on SCADA is thought to an android program and an html page via hosting. The envisioned system, which is controlled with SCADA, is aimed to be more flexible through internet. In the study, the pellet machine, which is frequently used in feed factories, is taken as a reference.

KEYWORDS: SCADA, PLC, Siemens, Php, Android, Hosting, Json.

1. INTRODUCTION

SCADA

SCADA is the abbreviation of the Supervisory Control and Data Acquisition[12-13]. SCADA, which was created to collect field information of the devices on large and wide area to a center, has become the main alarm axis where it was installed [1].

When the SCADA systems are examined structurally, it can be said that they are shaped according to the changes of the regions controlled. Factory related and similar compound controls as well as dispersed controls such as transformer stations can be carried out over SCADA. The SCADA system, which can reach multiple control points instead of a single control point, is called DCS. Industrial systems that provide the control of dispersed systems in a single center are DCS systems, another derivative of the SCADA system [2]. The difference between SCADA and DCS systems is the communication method which is the tool during the transfer of the information collected on the site to the center. In DCS systems, GSM base stations are used. In SCADA systems, communication is due to the communication cables that emerge as a result of the protocols [2].

The basic structure of SCADA consists of three main parts. These are MTU, RTU and communication systems [3].The MTU is called a grouped form of all the elements of the SCADA system. The MTU is the result of an abbreviation of the Master Transfer Unit word phrase [3]. In the operation of the SCADA system, it is the section where the interface between the controlled process and the user is created and serves as a manager in the SCADA system [3]. The whole of the systems that MTU uses to get all the information from the field is called RTU. It is responsible for transferring information from the remote terminal RTU to the interface screen, sending commands from the operator to the system and also applying the functions of SCADA [3].

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The hardware structure of the MTU varies depending on the nature of the processes that are being controlled. Generally, in the critical processes required from the MTU hardware structure, it is intended the system to allow rapid control of information [3]. In addition, real-time information monitoring and the occurrence of an operator in the event of a malfunction that may occur in some cases causes some changes in the MTU hardware structure [3]. These changes occur between the control computer and the number of operators [3].

RTU stands for Remote Terminal Unit [3]. Considering the tasks it has done, RTU can be stated as Remote Information Collection and Inspection Unit [3]. RTUs are examined in two groups according to their abilities and programmable structures [3]. In terms of programming, RTUs, which are passive, can only send and receive data to/from the main programmable RTU [3]. RTUs that are active in programming are also able to detect commands because of its programming capabilities other than the tasks of the other RTU group. RTUs are formed by the merging of six sections [3]. These are the communication unit, main processing unit, input and output isolation unit, user interface unit, test unit and power supply unit [3]. The main processing unit is only available in RTUs that can program [3].

The communication systems that provide the connection between MTU and RTU in SCADA technology have manifested itself in three stages from the past when SCADA existed [3]. While the first of these stages is a monologue communication between MTU and RTU, as a result of the innovations in the software worlddialog with the development of secondary generation communication on the computer to the database has been provided to receive information from the MTU. In the third generation database communication, the development of the secondary generation communication has entered a separate period and the data on the RTU is transferred directly to the database without having to undergo MTU [3].

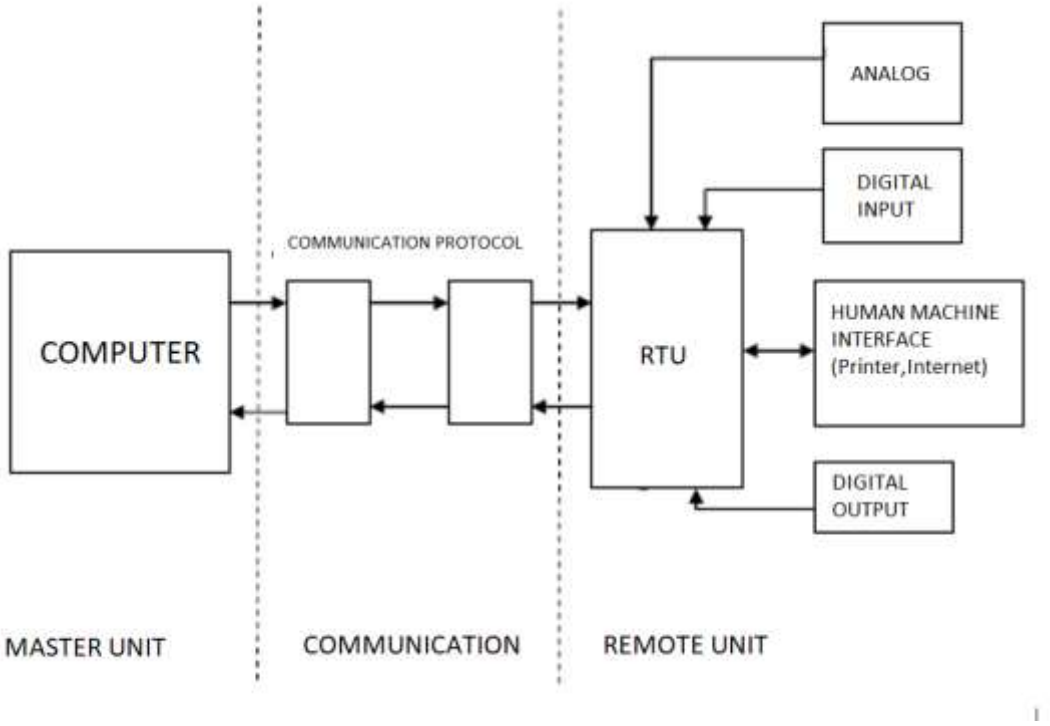

Figure 1. Structure of SCADA [3]

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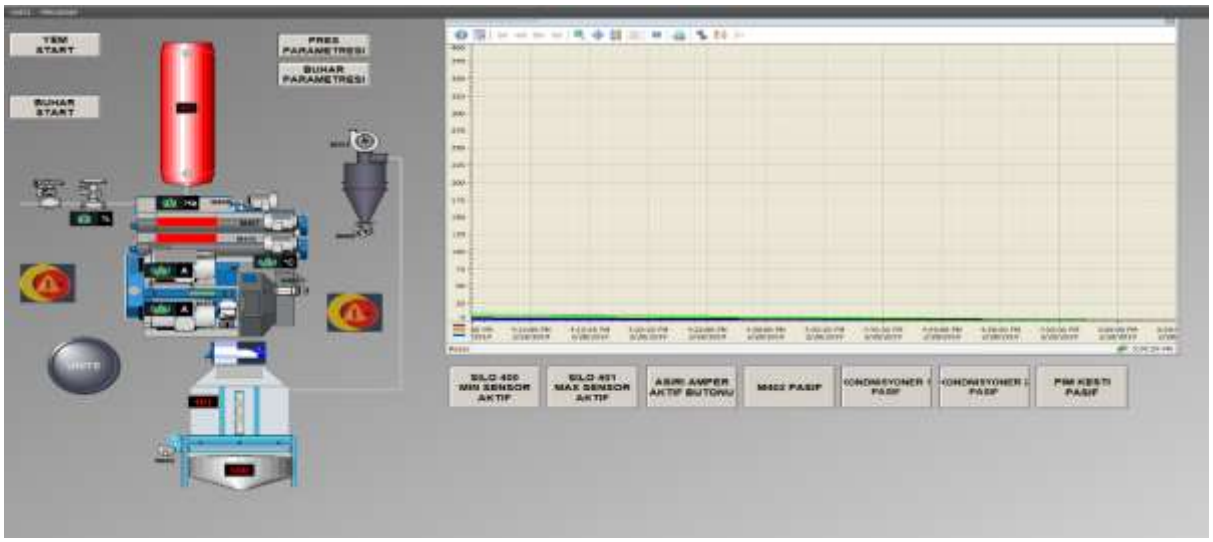

Figure 2. SCADA Structure of the Pellet Machine

PLC Structure

The PLC structure consists of 4 main and 2 auxiliary units. Input, memory, CPU and output sections are referred as the main unit group. The auxiliary groups are the interface and programming unit.

The input part is where the data from the field is completely collected on the PLC device[3]. Information from the field is transferred to the card before it reaches the microprocessor called CPU. The information coming from the field via optocoupler is transmitted without damaging the microprocessor [3]. The most important feature that distinguishes PLC devices from other commercially available microprocessor devices is a filtering feature against parasitic information in the field. Although the values vary between PLC devices, the filtering feature is still close to 15 ms. [3]. Due to the fact that the PLC production purpose is addressed to the industry sector. The voltage used on the PLC card is 24 V. For this reason, each sensor circulating on the field is returned to the input part of the PLC device as 24 V. As can be understood from here, the logic on PLC is accepted as logic 1 as 24V logic 0 if 0 V[3]. This refers to the PLC devices which are designed according to pnp input and output units. Some PLC devices are npn and logic is seen 0 as 1 and 24 V as 0 logic.

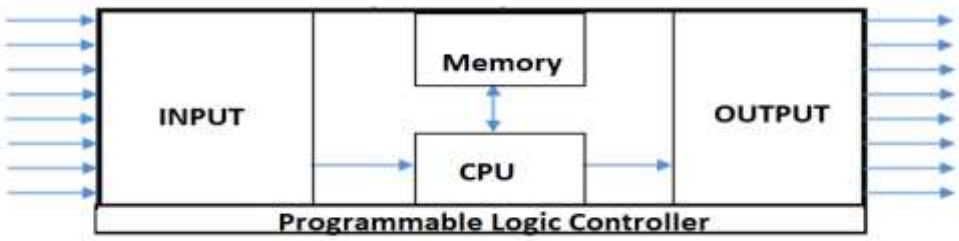

Figure 3. The Structure of PLC [3]

The PLC, which is a programmable control device used in industrial environments, can be located on every programmable card and it has a memory part. There are two memory sections as RAM and EEPROM in PLC devices [3]. RAM part is the memory part of PLC devices whose content can be easily changed. RAM is the part that keeps information from the input part before it is processed in the CPU [8-11]. That is the CPU's waiting room. The memory specified as EEPROM is the opposite of RAM memory. EEPROM is the memory part that keeps the information coming from the field always in the memory [3]. Important information is stored through EEPROM memory against the possible power outages in the field [3].

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The part of the CPU that is considered to be the brain of the PLC devices is the part that gives the card the output according to the information on the memory section. The RAM or EEPROM memory sections that collect the information coming from the input transfer data to the CPU according to the CPU's processing speed and according to this data sending data to the output unit by performing operations in the CPU takes place in this section. Although the CPU operating speed of the different PLC groups is different, this time period usually ranges from 0.8 ms to 0.15 ms [3].

Another part of the PLC devices is the output part. This section is often the part that causes us to see differences over time with the development of technology. The first exit sections are relay output sections. In time, the system needs and technological developments caused the addition of transistor output in addition to the system with relay output. Transistor-driven PLC devices produce an output voltage of 24 V according to the industrial system. This output voltage is set at 24 V and 220 V in the PLC devices with relay output. In today's technology, PLC relay outputs are produced as 24 V due to PLC safety logic.

Compatible with Android OS

The Android operating system, known as open source code and large library structure for mobile devices, has been brought to the point where it can work on any processor as a result of today's developments. The android operating system, which consists of four layers, creates a user interface with five application parts [4].

Linux, which enables the creation of Android operating systems, hardware drivers of mobile devices, software such as bluetooth and Wifi constitute the lowest layer of Android operating system architecture [4]. In the second layer, together with Android libraries, there are core libraries that are Android executives and the Dalvik Virtual Machine[4]. The Dalvik library is the component that enables the execution of an android application similar to a Java virtual machine [4]. This virtual machine is found in every android application, and provides a sandboxing for each application. There are services that can be used in applications known as the third layer application framework[4]. The fourth and last layer are main user applications such as making phone calls, sending messages, doing internet research [4].

Figure 4. Working of Android OS

Pellet Machine

Pellet Machine is a machine which is used in feed factories and enables powder feed cylinder volume. This machine consists of three main parts. These are the feeder, the conditioner, the pellet press part. The feeder section in the machine is the part that supplies the goods to the conditioners. With the inverter to be installed in the motor to be used in the feeding section, the speed of the product is adjusted according to the main motor

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currents that rotate the pellet press. The conditioner is used to moisturize dry matter coming from the feeder to a certain extent. The steam to be supplied is adjusted according to the temperature on the product. Finally, Pellet press part is the section where the incoming product in the form of moist powder is pelleted. Here, there are two pellet discs. Pellet discs are driven by the help of two main motors with a single belt.

The pellet from the pellet machine is then transferred to the cooling machine in the process to remove the temperature on the feed. With this transfer process, the temperature of the pellet in the cooler drops from 70 °C to 20 °C. For cooling the pellet of the cooler, a machine, which is considered as a fan, is used. During the cooling process on the fan, as well as the pellet, the product falling into the cooler must not go outside the factory from the fan. Therefore, a machine called cyclone is used under the fan. Cyclone allows air to be discharged from the factory by means of a motor with air lock and it brings the remaining food back which is dust into the factory.

Figure 5. Pellet Machine

2. MATERIALS AND METHODS

Transferring Simatic Manager Program to Simulation

Siemens gives special importance to the simulation part in order to make it easier for the software developers to control the software developed in industrial packages. On the first interface of the Simatic Manager program, the simulation used to test the scenario of any machine on the program and to observe the reaction of the written scenario, it is possible to move forward by clicking the icon. By clicking on the icon, the program written via the faceplate allows Siemens to operate on PLCSIM or virtual PLC instead of running it on a PLC device [5].

There are two important considerations when loading the program into the virtual PLC interface of the Simatic Manager. One of these is the determination of PLCSIM.TCP of Set PG/PC Interface setting in the Simatic Manager programas 1. This setting in the program allows the selection of the communication option to be made between the PLC device used and the computer on which the program is installed. PLCSIM.TCP 1 communication method was preferred because the work carriedwas a simulation system [5].

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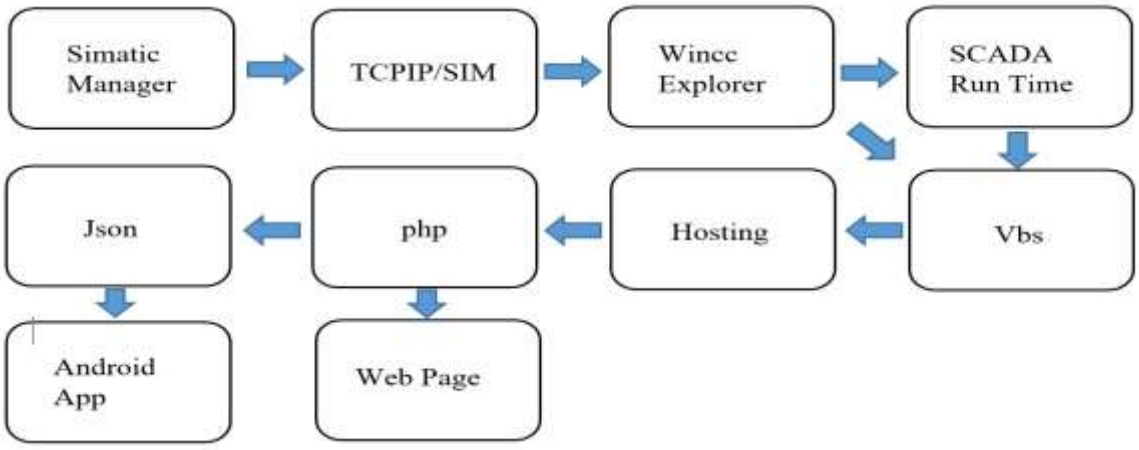

Figure 6. In Study Plan Of System

Data Transfer from PLC to SCADA

The database in the program structure has a special place. As described in the function blocks, while database is used to store the latest data values on the block parameters, in addition giving information to the parameters used in the program, it allows this information to be used in other sections of the program. The communication between the PLC and SCADA is made between the bits of information called tag. SCADA provides the visuals specified by the tags that it takes from PLC. In order to make data transfer easier, the combination of these tags in the Siemens industry package program has created the tag clusters so-called DB sets [5]. The software installed on the PLC ensures that the values of the parameters as a result of the information received from the field are kept in the WBs.

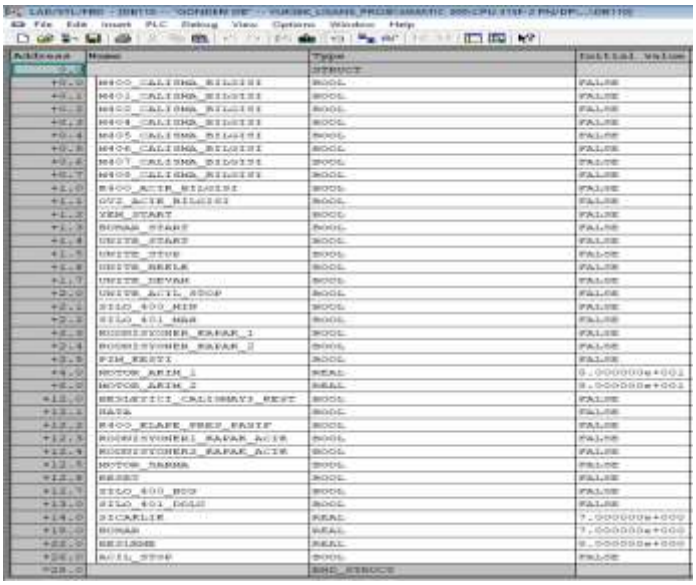

Figure 7. DataBase Data in the Study

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Tags [GONDERIM]

	Name	Comment	Data type	Length	Format adaptation	Connection	Group	Address
1	ACIL_STOP		Binary Tag	1		PLC	GONDERIM	DB110,D26.0
2	BESLEME		Floating-point number 32-bit IEEE	4	FloatToFloat	PLC	GONDERIM	DB110,D022
3	BESLEYICI_CALIS_KESTI		Binary Tag	1		PLC	GONDERIM	DB110,D12.0
4	BUHAR_DEGERI		Floating-point number 32-bit IEEE	4	FloatToFloat	PLC	GONDERIM	DB110,DD18
5	BUHAR_START		Binary Tag	1		PLC	GONDERIM	DB110,D1.3
6	HATA_OLUSTU		Binary Tag	1		PLC	GONDERIM	DB110,D12.1
7	K400_ACIK_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D1.0
8	K400_KLAPE_PASIFE_GECTI		Binary Tag	1		PLC	GONDERIM	DB110,D12.2
9	KOONISYONER1_KAPAK		Binary Tag	1		PLC	GONDERIM	DB110,D2.3
10	KOONISYONER1_KAPAK_ACTI		Binary Tag	1		PLC	GONDERIM	DB110,D12.3
11	KOONISYONER2_KAPAK		Binary Tag	1		PLC	GONDERIM	DB110,D2.4
12	KOONISYONER2_KAPAK_ACTI		Binary Tag	1		PLC	GONDERIM	DB110,D12.4
13	M400_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.0
14	M401_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.1
15	M402_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.2
16	M404_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.3
17	M405_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.4
18	M406_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.5
19	M407_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.6
20	M408_CALISMA_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D0.7
21	MOTOR_SARMA_YAPTI		Binary Tag	1		PLC	GONDERIM	DB110,D12.5
22	MOTOR1_AKIM		Floating-point number 32-bit IEEE	4	FloatToFloat	PLC	GONDERIM	DB110,DD4
23	MOTOR2_AKIM		Floating-point number 32-bit IEEE	4	FloatToFloat	PLC	GONDERIM	DB110,DD8
24	OV2_ACIK_BILGISI		Binary Tag	1		PLC	GONDERIM	DB110,D1.1
25	PIMKESTI		Binary Tag	1		PLC	GONDERIM	DB110,D2.5
26	RESET_ORTAYA_CIKTI		Binary Tag	1		PLC	GONDERIM	DB110,D12.6
27	SICAKLIK_DEGERI		Floating-point number 32-bit IEEE	4	FloatToFloat	PLC	GONDERIM	DB110,DD14
28	SILO_400_MIN		Binary Tag	1		PLC	GONDERIM	DB110,D2.1
29	SILO_401_MAX		Binary Tag	1		PLC	GONDERIM	DB110,D2.2
30	SILO406_BOS		Binary Tag	1		PLC	GONDERIM	DB110,D12.7
31	SILO401_DOLU		Binary Tag	1		PLC	GONDERIM	DB110,D13.0
32	UNITE_ACIL_STOP		Binary Tag	1		PLC	GONDERIM	DB110,D2.0
33	UNITE_BEKLE		Binary Tag	1		PLC	GONDERIM	DB110,D1.6
34	UNITE_DEVAM		Binary Tag	1		PLC	GONDERIM	DB110,D1.7
35	UNITE_START		Binary Tag	1		PLC	GONDERIM	DB110,D1.4
36	UNITE_STOP		Binary Tag	1		PLC	GONDERIM	DB110,D1.5
37	YEM_START		Binary Tag	1		PLC	GONDERIM	DB110,D1.2

Figure 8. SCADA Dataset in the Study

Data Transfer from SCADA to Hosting

The information that comes from PLC to SCADA is used in Wincc Explorer program for transferring information to a hosting software. The Vbs script language cycle time settings selected from the Global Script pane are done on the global script pane. In order to do this setting, clickin Ctrl+T in any script language is enough. From the emerging Properties window, it is possible to set the script language cycle time with any tag or any timer if desired[7].

In the software written first, specifying the variables to be used within the software is aimed [7]. As a result, it is considered appropriate to write the names of the data to be sent to android application and html application on variable names.

```
Dim M400_CALISMA_BILGISI
Dim M401_CALISMA_BILGISI
Dim M402_CALISMA_BILGISI
Dim M404_CALISMA_BILGISI
Dim M405_CALISMA_BILGISI
Dim M406_CALISMA_BILGISI
Dim M407_CALISMA_BILGISI
Dim M408_CALISMA_BILGISI
```

Figure 9. Data Descriptions Required for Data Exchange Between SCADA and Hosting

SCADA is a real-time programming type. Therefore, the instant changing of the incoming tags will cause the android application and the information that falls on the internet page to request information instantly. *"HMIRuntime.Tags("").Read"* command will allow SCADA to read the information in the system based on the cycle time when it switches to the real-time format.

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```
M400_CALISMA_BILGISI = HMIRuntime.Tags("M400_CALISMA_BILGISI").Read
M401_CALISMA_BILGISI = HMIRuntime.Tags("M401_CALISMA_BILGISI").Read
M402_CALISMA_BILGISI = HMIRuntime.Tags("M402_CALISMA_BILGISI").Read
M404_CALISMA_BILGISI = HMIRuntime.Tags("M404_CALISMA_BILGISI").Read
M405_CALISMA_BILGISI = HMIRuntime.Tags("M405_CALISMA_BILGISI").Read
M406_CALISMA_BILGISI = HMIRuntime.Tags("M406_CALISMA_BILGISI").Read
M407_CALISMA_BILGISI = HMIRuntime.Tags("M407_CALISMA_BILGISI").Read
M408_CALISMA_BILGISI = HMIRuntime.Tags("M408_CALISMA_BILGISI").Read
```

Figure 10. Reading Data to be Transferred to Hosting from SCADA

It is ensured that the information coming instantly is placed in the database by means of the internet hosting. The connection between the ODBC Driver and the server connection is provided by writing hosting server domain, port, database name and hosting server user name and password.

```
strConnectionString= "DRIVER={MySQL ODBC 5.3 ANSI Driver}; SERVER=rattle.guzelhosting.com;
PORT=3306; DATABASE=mahmutke_yuksek_lisans_mahmut; UID=mahmutke_bilgeamc_mahmut; PASSWORD=Mahmut.12345;
Option=3"
```

Figure 11.Communication between SCADA and Hosting

The information to be sent to the database on the hosting server is matched by creating a database table. Information is provided to the database created with an SQL variable through the hosting connection. In the generated SQL table, the variable names that are to be transferred are first. Then the instantaneous values of variable names are taken from the field.

```
Dim urunSql
urunSql = "INSERT INTO scada ("&_
"`M400_CALISMA_BILGISI`,"&_
"`M401_CALISMA_BILGISI`,"&_
"`M402_CALISMA_BILGISI`,"&_
"`M404_CALISMA_BILGISI`,"&_
"`M405_CALISMA_BILGISI`,"&_
"`M406_CALISMA_BILGISI`,"&_
"`M407_CALISMA_BILGISI`,"&_
"`M408_CALISMA_BILGISI`,"&_
```

Figure 12. Transferring the Data Name to Be Sent to SQL Server to SQL Server Mode

```
  "VALUES (" &_
M400_CALISMA_BILGISI & ","&_
M401_CALISMA_BILGISI & ","&_
M402_CALISMA_BILGISI & ","&_
M404_CALISMA_BILGISI & ","&_
M405_CALISMA_BILGISI & ","&_
M406_CALISMA_BILGISI & ","&_
M407_CALISMA_BILGISI & ","&_
M408_CALISMA_BILGISI & ","&_
```

Figure 13. Transferring the Data to Be Sent to SQL Server to SQL Server Mode

Database Feeding the Web Page

The folder where all the files required for web page design is collected is called Codeigniter. Codeigniter folders are used in static page design and dynamic page formatting for html web pages. The database transferred to the hosting computer with a software named database.php in the Codeigniter folder is also transferred to the web page which is again on the hosting computer.

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The connection cluster elements required for the transfer of information between the database and the web page are hostname, username, password and database. In addition, the remaining connection elements are available for use in format settings on web pages. Hostname is used to specify the hosting domain address used. In the application the hosting device of the güzelhosting company was used. Each hosting company has a user name and a password that they give to their users. In the setting, the user name is mahmutke_bilgeamc_mahmut and password has been determined as Mahmut12345. In the account to be used, specifying which database the data will be taken from is done with the database setting. Data transfer in the application was done using mahmutke_yuksek_lisans_mahmut database.

Figure 14 Web Page Database Connection Information

Data Mapping Between Web Page and Android

The information to be sent from the web pages to the Android operating system was carried out via a php extension software that enables the web pages within the contaigner folder to become dynamic. After the information received from the database comes to the script in the background of the website, it was ensured that it falls to the android application over the help of json libraries.

*$ q = $ this-> db-> query ("select * from scada order by id desc limit");* q is assigned to the database so that the database library with jquery could be assigned. Here later with the *foreach ($ q-> result_array () as $ k)* command by assigning the variable q to the k variable, the single incoming data is divided into parts.

It was intended to transfer the divided data the command to the android operating system in an easier way *Json_encode (array)* command. During this transfer process, the values of the data taken from the database are taken with the command *$k[""]*. Finally, the value of the data was defined by the Json command. Below, the value of the data and the variables of the data are shown in the php software.

*$ q = $ this-> db-> query ("select * from scada order by id desc limit");* q is assigned to the database so that the database library with jquery could be assigned. Here later with the *foreach ($ q-> result_array () as $ k)* command by assigning the variable q to the k variable, the single incoming data is divided into parts.

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Figure 15. Transferring Data from Web Page to Android Program

3. CONCLUSION

In the study considered for the systems used in industrial sectors, control with android and internet-based applications is handled were dealt with in addition to SCADA telemetry systems. The process of the pellet machine, which is frequently used in feed factories as industrial process, is determined as reference.

From Siemens Manager industrial package programs, Step 7 Simatic Manager program and Wincc Explorer programs were preferred. In the light of the information that come instantly to Wincc Explorer program, data is transferred to the database established on the hosting with the script written on the program.

It is intended to add a cycle time to the body part of the page in order for the data transferred to the hosting database to come instantly to the html page. Thus, it is planned to keep the information coming from the background of the page fresh. The web page works depending on the modems specified in terms of security. In other words, it is not possible to access the internet site by another modem. In this study, it has been enabled to create management concept.

For the system which is also controlled from the android application android studio program is used along with the web page. In this page design, the data were taken via the website page. Like the Internet page, the cycle time is added to the android application.

These days when we have started the age of internet and smart device, industrial developments find themselves in this sense. For this reason, in Industry 4.0 and 5.0 Applications courses, now in addition to industrial HMI, SCADA systems there is the addition of web page and android applications for the interface programs. According to this table, the opinion is dominating that industrial libraries now should be supported by the software developers for Android and iOS applications.

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